

The Envenoming Pandemic and the Misguided Views of Snakes: Developing Sustainable
Relationships Between Native Poisonous Snakes of India and the Citizens of Maharashtra
Through the Use of the Irula Model.

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ABSTRACT

Due to its vast population and general negative consensus regarding snakes, India is notorious for having more snakebite incidents than any other country. Snakes are simultaneously revered and feared in Indian religion and culture. This stigma is perpetuated through propaganda, family beliefs, and innate fears of snakes. These stigmas are more pronounced within rural areas, such as the region of Mahad within the state of Maharashtra. Envenoming is endemic in these areas, and others like them. The World Health Organization identified envenoming as one of the most neglected tropical diseases of the 21st century (Nature India, 2013). Additionally, both nonvenomous and venomous species of snakes are killed haphazardly, reducing the biodiversity within the environment and effectively causing more envenoming through active human effort to seek out and kill snakes. The objective of this report is to examine the evidences for connections between human killings of snakes and the number of envenoming cases, and to demonstrate the benefits to people and snakes through sustainable management. This paper will describe methods and opportunities for changing the public perception of snakes using the famous snake charmers of Irula as a model which will be used to strategize a conservational proposal within Maharashtra in protecting both snakes and people.

Indian Culture

Globally, snakes have invoked strong feelings from humans that stem either from fear and horror, or respect and reverence. In either case, snakes have inspired both superstition and religious folklore. In Hindu and Buddhist mythology, the image of the snake is often referenced to "Nagas," or hybrid human-snake beings that serve under the god of serpents, "Vasuki" (Jairraipuri, 1991). As scripture goes, the god of "Nagas" serves to protect and worship other enlightened beings, such as Buddah. Cobras are especially idolized, as their image is always in reference with many Hindu gods as supporters of gods and their holy endeavors (Jairraipuri, 1991). Additionally, it is believed that cobra's affiliation with gods gives them great power of fertility, and many temples worship snakes out of this ideology (Jairraipuri, 1991). It's easy to see how snakes are centralized in Hindu and Buddhist religion, so it's no surprise that the killing of snakes is seen as a sacrilegious act. However, though some parts of India's society live by the words of gods, others take from these ominous figures and draw fear instead of respect.

Ophidiophobia and Mechanisms of Fear

The fear of snakes, or "ophidiophobia," stands as one of the most prevalent fears worldwide (Davey et al., 1998). While certain snakes indeed are deserving of such fear, others are not, and are relatively harmless. Phobias of any kind stem from the rational fear that something, such as a snake, has the potential to harm. Phobias, however, exaggerate these reactions, resulting in an irrational responses. They can be present in individuals who have never seen a snake, nor lived in an area populated with snakes, and the fear can seem out of proportion to other more present hazards. Two theories have attempted to explain why phobias exist. The Seligman preparedness theory

hypothesizes that animals have directed their fears to focus on certain phobias that have proven fatal for their ancestors, and that this direction of fears is manifested as a selection pressure that helped mold the adaptive evolution of that individual, resulting in a preposition to be aversive to that fear (Davey et al., 1998). Though this theory provides some insight, it still doesn't account for the why the fear of snakes is far more universally expressed among humans than, say, bears or lions. Matchett and Davey propose a different route (Davey et al., 1998). Their model operates similarly to Seligman's theory, with the exception that phobia is based on viability of food and limits of disgust. Risk of contamination not only includes food, but also animals that elicit a disgust response, such as snakes, spiders, and slugs (Davey et al., 1998). Potentially, the tendency for people to avoid snakes is rooted in the belief that they may contaminate and bring illness upon humans. These concepts help us try to rationalize the irrational fear of snakes, but other studies claim that these fears may be simply be due to genetic factors and classical conditioning through family influence. The answer behind snake phobia most likely lies in the middle ground of all of these assumptions, however, fear and what enables fear isn't completely understood. What is known is that snake phobias are a difficult to overcome and cannot be addressed by reasoning alone. Studies have shown that attitude changes toward phobia-inducing animals were not swayed by education, though their knowledge of the animal was enhanced. Experimental desensitization of phobias was studied by Lang and Lazovic (1963), where in their experiment they had each subject fill out a fear survey at the beginning of the experiment and 6 months after the experiment, reporting their level of phobic fear from a scale of 1-7. The experiment tested whether subjects who were snake phobic, could attempt to approach a snake and possibly eventually even hold

a snake. The approach was observed under two conditions: one supplemented with information on the snake in an attempt to logically define why the subject was afraid, and another that did without understanding of the phobia. Data resulted in that under these conditions, no subject was better off overcoming their phobia, and that the main determinant in changing attitudes towards snakes came from continual interaction (Lang and Lazovic, 1963). Additional data from Morgan and Gramann (1989) and Geer and Turteltaub (1967) support these findings and recommended using modeling as the most effect means to overcome phobias of snakes. Persistent irrational fear is what continues to devalue and demonize the snake, especially in countries like India, where the emphasis of religion and culture heightens the fear of snakes for many rural inhabitants.

Taking advantage of the enigma of snake phobia were the once famous Irula snake charmers of Andhra Pradesh, Mahrs of Maharahtsra and Saperas of North India. These tribal people are adapt at snake catching and use their expertise and the social fear of snakes to bring in crowds with their "charming" (Das, 2012). Snake charmers were viewed as social outcasts, their culture and lifestyle primitive with respects to modern India. They heavily relied on their ancient traditions of snake catching as their main source of income (Das, 2012). The perpetuation of the myth that surrounds snakes is vital for their success as charmers, as their nomadic lifestyles and unique upbringing mark them as social pariahs. The image of the snake is one that is well known in India, deemed either vicious or righteous, the snake absorbs its audience into believing that its presence is one to contend with. The cultural and religious practices performed in India only serve as more evidence that there lies a deeply embedded distrust and fear of snakes, and that this distrust is fostered through these cultural practices.

Snakes and Man

Snake associated fears often dissolve any personal or cultural appreciation for the value of snakes to ecosystems and human communities. Snakes are essential for maintaining biodiversity and food chain dynamics, but what is lesser acknowledged is that snakes can benefit humans in many ways as well. Humans operate in a very binary manner, for the sake of practicality and by human nature to judge by first impression. Many snakes that are killed are nonvenomous and only serve as natural pest control. There are many facets in human culture and science where snakes play an active role, one of them being excellent subjects for environmental research. Snakes, like other reptiles, are cold blooded, and heavily rely on the success of the environment in order for them to thrive. For instance, changes in temperature and humidity would drastically alter the ability for snakes to thermoregulate, which affects the biochemical processes within their body, such as metabolism. Because snakes are more immediately sensitive to thermal characteristics than mammals or birds, they are excellent indicators of environmental changes, like alterations in thermal profiles, which may be in association with plant growth and prey availability (Jairajpuri, 1991). Working class rural farmers areas are the most common victims of snake bites. Encounters with snakes in the field are treated as a pest problem. Many farmers do not appreciate the value snakes can serve to them as predators of their real pests. Farmers make their mainstay based on the yields of their crop, and are ever diligent to protect it's vitality. Pesticides and traps are set, but are often too expensive to afford and additionally may cause adverse affects to other desirable wildlife and plants (Konar and Modak, 2010). Snakes are far more effective as natural pest control for birds, lizards, and especially mice, which pose the most threat to a

farmer's crop and property. What highlights the snake as the best rodent deterrent is its sleek shape which allows it to fit into cracks, holes, and mouse dens, effectively exterminate rodents and their future offspring (Konar and Modak, 2010). This inturn also relieves collateral damage done by mice through their gnawing behavior, which removes the additional stress of paying for repairs on the farmers behalf (Konar and Modak, 2010). Unfortunately, arbitrary snake encounters incite fear and hostility in farmers, which result in numerous snake deaths. Unknown to the farmer is that this hostility may actually be fostering the more likelihood of encountering a venomous snake rather than a nonvenomous one. The killing of nonvenomous snakes that compete for prey with the venomous species may increase the opportunity for venomous snakes to expand into heavily populated areas, and additionally increase their contact with humans (Balakrishnan, 2010). In both instances, killing snakes may negatively affect human communities and the environment. Cultural norms that encourage indiscriminate snake killing may contribute to the high number of envenoming cases that are reported every year in India. Human health and the environment would both stand to benefit from reshaping community attitudes towards snakes by recognizing how beneficial nonvenomous snakes can be to human societies.

Threats to the Snake

As human civilization expands, it intrudes and impedes into the environmental sphere, causing adverse consequences for the natural wildlife around them. Anthropogenic activities present a threat to the integrity of the survival of animal populations. While some are seen as directly harmful activities, such as deforestation, there are more complicated activities that are poorly recognized and understood. Snakes

being of the few animals that are immediately reflective of the environment are often the first to feel the affects of anthropogenic activities. The first of which are direct killings by humans. A survey dispensed from January 2008 to December 2010 sampled ten villages where direct killing of snakes amounted to 278 killings, which summed up to seven snakes per year and per village (Das, 2013). Movement of humans into snake territory forces snakes to relocate and reside within human communities. The dispersal of snakes within these communities are often fueled by instinctive drive to hunt, seeking of mates during mating season, and migration of gravid females in search of optimal egg-laying conditions (Bonnet et al., 1999). As a result of the migratory characteristics of both man and snakes, encounters are occurring more often. Death by direct human killing has become so naturalized that snakes are continuously killed out of impulse. In rural areas, farmers are encouraged to kill snakes, believing that they hinder production and threaten their personal security (Whitaker and Shine, 2000). Snake hunting allows a greater chance for envenoming to occur. Often times hospitals are not well equipped to treat snake bites, so snakes are killed are taken to the hospital for identification, in hopes of accelerating the process of recovery for victims (Baawaskar and Bawaska, 2004). Not surprisingly, this protocol increases the likelihood for more envenomings to occur, which continues to further demonize the snake as a predator of humans (Whitaker and Shine, 2000). Farmers are also indirectly killing snakes through their agricultural practices. The clearing of forest for agricultural expansion combined with the use of chemical fertilizers and pesticides, destroy habitats and poisons snakes (Das, 2013). It was found that 95% of farmers were using banned chemical pollutants such as DDT, dieldrin, and mirex as supplementary pesticides and fertilizers for the growth of hybrid seeds (Das, 2013). Other

more complex factors attributing to snake deaths are human technologies and their association with the environment. The construction of buildings and the clearing of fields often upset the dynamics between prey and predator species. For example, birds that hunt snakes are at an advantage if there are more elevated points to scan the area. It makes it especially effective if the grasses that used to hide snakes have been cleared allowing for easier viewing (Bonnet et al., 1999). The implementation of roads also have lead to the increased death of snakes that are migrating because of lack of food security, mating privileges, and egg-laying grounds. Vehicles are what levels the population of snakes down to pitiful numbers. Behaviors of the snakes based on gender, size, age, and species are all vulnerable to the effects of vehicles. If a snake is successful in escaping predation because of it's size, gender, age, or species it will still fall victim to vehicles. (Bonnet et al., 1999). The presence of humans has caused even seemingly "natural" deaths of snakes to be actually a product of human construction. Humans have become so much apart of the environment that the word "natural" and "human caused" cannot be separated (Bonnet et al., 1999). If the survival of snakes is to be desired, humans must actively make an effort to do so. The objective now would be to create more innovative ways to manage relationships between humans and snakes so that they live in concordance. The death of snakes and envenoming of humans are only the symptoms of the lack of understanding between the two species.

Envenoming: The Farmer's Plight

Snake bite envenomation is an accelerating and reoccurring theme that characterizes regions like Maharastra. Maharashtra, as India's wealthiest state, and second only to Uttar Pradesh as the most populated state, suffers most significantly from the brunt of

venomous snake bites. The state is known for its financial capital, Mumbai, but scattered across its lands are rural areas, such as Mahad, where village farmers are often the victims that go unnoticed. It's estimated within India that there are 35,000–50,000 snake-bite related deaths yearly, and 2,000 of those deaths occur within Maharashtra (Prabhakaran, 2005). Maharashtra's annual incidences accumulate to envenomation is about 70 per 100,000 inhabitants and the mortality rate is about 2.4 per 100,000 per year (Chippaux, 1998). A survey found that 97% of these incidences occurred in rural areas where 59% of the victims were male, suggesting that farmers, which are occupations usually filled by men, face snake bites as an occupational hazard (Nature India, 2012). It's been noted that snake bites have been labeled "a disease of the poor", because it primarily affects subsistence farmers worldwide, as well as in Maharashtra (Harrison et al., 2009).

The majority of snake bites are caused by the common krait, which is regarded as the most lethal venomous snake in India, with a documented 35%-50% fatality rate. The Asian or speckled cobra is another common species highly associated with envenomation (Bawaskar et al., 2004). The behavioral characteristics of snakes and occupation and living conditions of farmers often have the two meeting in unfavorable conditions. Because of the warm climate, geography dense with vegetation, and water abundant during monsoon seasons, run-ins with snakes are common to farmers. When brush is high, it's common for farmers to walk barefoot over the grass during monsoon season, June through October. Kraits are active during this time because the rain floods rodent burrows, flushing them out into the open. In a study led by Bawaskar (2004) documenting frequency of krait bites, it was found that 85% of reported cases occurred between midnight and 5 am during heavy rainfall. These conditions and window of time are in

sync with when farmers are most productive. Additionally, about 5,000–7,000 snakebite fatalities per month occurred during the monsoon period, versus the 2,000 deaths in the winter months (Aliroll, et al., 2010). Farmers reside in narrow accommodations, usually small huts, where it's customary that they sleep on the floor. However, these lifestyles make farmers, and their families, more prone to krait bites. Kraits are nocturnal by nature and are attracted to the "wattle and daub" fashion of the huts. The mud huts often have waste material, firewood, and farm tools in close approximately, cultivating unsanitary conditions attractive to rodents and lizards, which are common prey items for snakes (Bawaskar et al., 2008).

Though farmers are well-known victims of snake bites, reported incidences do not justly characterize the gravity of the situation. The numbers collected on snake bites are estimates, and are inaccurate because rural areas often don't report these cases to hospitals. In actuality, the number of incidences may be far greater. Many villagers turn to traditional healers for envenomation or rely on their own self medication, as many primary care physicians within the area are ignorant of the correct treatment of snake bites (Rahman et al., 2010). 75% of all victims receive attention/care within two hours of the snake bite, 86% of the victims turn to the village healer to seek treatment, and only 3% percent go directly to the hospital after being bitten (Rahman et al., 2010). The void of attendance at local hospitals for the treatment of snake bites stem from faculty not being properly trained. Because physicians are unable to read the symptoms of snake bites, villagers often kill the perpetrated snake and take it to the doctors so that they can identify what kind of venom they need to address (Bawaskar and Bawaskar, 2002). However, even then, most doctors are still not familiar with the procedure. The

conventional medical understanding needed for snake bite victims would include tracheal intubations and ventilation by an amboo bag or artificial ventilator in neuro-toxic envenoming, awareness of the golden standard 20 minute whole blood clotting (20WBCT) and bed side tests to monitor the blood clotting (Bawaskar, 2008). Additionally, better understanding of snake venom not only saves lives, but it contributes to the science of human physiology and pharmacology. Information on the nature and mechanism of action of these toxins enables more scientific approaches into other ailments that are also specific to rural areas (Omar, 2013). Because of Maharastra's inadequate clinical services within rural areas, incidences go undocumented and untreated. The need for better understanding of snakes, medically, biologically, and socially are evident for the success of both man and snake.

A Model for Conservation: The Irula Method

The conservation of snakes are heald in high opposition for various reasons. The main reason being that negative attitudes remove interest in protecting such species to begin with. Unlike mammals, people don't tend to identify with reptiles, and their cold appearance is off putting to most people. Snakes especially carry the burden of the social stigma as predatory killers of man. As a result, allocation of conservation funds for reptiles, and especially snakes, are extremely scarce (Dodd, 1993). Even for experienced herpetologists and conservational biologists, relative research on status amassment, recovery, and management of snakes have been few and far in between (Dodd, 1993). When conservation methods are executed, usually through education, it's often an expensive task that yields a low outcome of success. The situation specifically within Mahad, Maharastra makes the educational routine difficult to administer, because many

rural villagers will most likely be hesitant to listen to any authority outside of their niche. Referencing previous trials of snake conservation, conservation methods need to be integrative and unconventional (Dodd, 1993). Instead of approaching the problem linearly, what this paper proposes is to unanimously join human and snakes to form a sustainable relationship between the two. The development of sustainable relationships between human and snakes will follow by example of the Irula Cooperative Society (ICS). With the assistance of the Irula people, civilians can learn to be in partnership with snakes that promote the development of self sufficiency for the civilians and improved living conditions for snakes to thrive.

Irulas are the tribal people of the Chinglepet District in Tamil Nadu, and are most famously known as the iconic snake charmers of India. The Irula people have maintained the lifestyles of their ancestors by subsisting largely on hunting and gathering. Their traditional ways make survival difficult for them to adapt to modern India, as emerging ecological and social unsustainability threaten their way of life. As snake hunters, they manage their primitive lifestyle through "charming snakes" or, preferably, by catching snakes and selling snakeskins as exports (Konar and Modak, 2010). Their image in society is more or less that of gypsies, being seen as outsiders that captivate their audience with unconventional practices. The primary livelihood of Irulas are founded in their hunting of snakes, which has become not only their specialty, but is the only skill they can use to support themselves financially (Konar and Modak, 2010). In 1972, the Indian Wildlife Protection Act proposed a ban on the "charming" and capture of snakes for the export of their skins (Konar and Modak, 2010). From that point on, the Irula, who are completely dependent on snake hunting, became criminals out of simple principle to

survive (Konar and Modak, 2010). In response to the new social order, the Irulas set up a new cooperative society in which their snake expertise would be used for the conservation of snakes and the production of anti-venom (Konar and Modak, 2010). The Irula Cooperative Society (ICS) stands today as one of the most exceptional examples of social ingenuity in India, and is directly managed by the Irula community themselves. As a disadvantaged group, this new enterprise was able to generate necessary income for the Irulas, so that they can persist in Indian society. The profit from the cooperative is sent directly to its members, instilling self-sufficiency through skills they already possessed, and using it to now conserve the snake and decrease fatalities of envenoming by providing antivenom (Konar and Modak, 2010). The objectives by which the ICS conducts its business are as follows:

- (a) To secure adequate volume of snake venom for the the production of anti-venom.
- (b) To enforce the protection of snakes under the Wildlife Protection Act of 1972, so that they are in no way compromised of their safety, that is, snakes, are caught for the sole purposes of extraction of snake venom needed for medicinal purposes, and are released without inflicting harm after the extraction.
- (c) To guarantee that the Irula tribal people are given the opportunity of securing employment through the use of their pre-existing skills.

By alliancing the need for better treatment and understanding of snakes with the need of the Irula tribal people to be self-sustaining, the ICS has created a program that simultaneously addressed both concerns. The cooperative is aware of the importance of snakes, and sees the opportunity of their conservation as a means to conserve man himself. Unlike commercial snake farms that operate by profit and breed snakes based on

the demand as a commodity, the ICS only operates to fulfill minimal living standards for the Irula tribal community (Konar and Modak, 2010). The indigenous knowledge and skill sets of the Irula promote sustainable living standards for humans, maintains ecological homeostasis of snakes, and possess environmental and social accountability. The ICS has been met with so much success that it has influenced the conception of other cooperatives in various other disciplines, such as, reforestation by implementation of plant nurseries (Konar and Modak, 2010).

By drawing upon the Irula Cooperative Society as a model and by modifying and allowing integration of other conservational methods, conservation of the both venomous and non venomous snakes is possible within Mahad, Maharashtra. The Irula method is particularly attractive to the conservation of snakes because of how specifically it targets human and snake relationships through hands on interaction. It's been suggested by Morgan and Gramann (1989) that many conservational efforts rely too much on educational reinforcement to change attitudes about wildlife. Instead, what they proposed is that there be an emphasis on researching the effectiveness of certain teaching strategies that yield better results, so that funding can be used more wisely. Phobias are extremely resistant to change via informational messages, better alternatives would be by continual exposure, direct contact, and modeling. Continual exposure by frequent visits to zoological parks and wildlife sanctuaries, direct contact by personal experience, and modeling by following by example (Morgan and Gramann, 1989). The Irula embody all of what Morgan and Gramann suggest to be most effective for attitude changes in snakes. The Irula's continuous exposure to snakes under healthy symbiotic context, provides a model for Mahad inhabitants to follow suit. What makes the Irula tribal people an

effective vessel for change is that the Irula are already well known by most people within India. Although they are still considered outcast in some aspects, their work in the field is relatable to that of farmers. Both are considered financially disadvantaged and both primarily work outdoors in the fields following tradition methods. One of the biggest challengers mentioned in snake conservation is convincing rural villagers to change methods, but if the Irula are facilitating these changes, the outcome is more likely to succeed because they are closer to the niche of farmers than authoritative conservation specialists are. For subsistence farmers who are financially burdened by the snakes and their snake bites, they can learn how to better read snake behavior, understand proper snake handling techniques, and additionally supplement their finances through the same methods of the Irula, by catching snakes and selling venom.

The more frequent positive encounters become with snakes as a result of skills adapted from the Irula, the better the social implications for the image of the snake. Ultimately, by seeing the usefulness of snakes as being in partnership with the success of humans, agriculturally and environmentally, the stigma of snakes should gradually dissipate, and the barriers between human and snakes can be integrated into one common goal, to thrive and coexist among each other as neighbors.

The proposed conservational plan will be as described:

- I. Demonstrate to subsistence farmers the revised image of the former "snake charmer" by allowing them to shadow the Irula at the cooperative on a daily basis.
- II. Have the Irula teach the farmers about the inherent behaviors of snakes and what they can do to accommodate changes to their lifestyles to make

encounters with snakes less frequently fatal.

A) Farmers will be able to identify snakes, nonvenomous from venomous, by behavior and appearance. Behaviors such as those which are most active at night and appeal to certain dwellings, such as huts or abandoned rodent dens.

B) Farmers will make rearrangements to their living quarters to discourage what is behaviorally attractive to snakes. Regulating maintenance around and inside huts can deter rodents, which are attractive to snakes. Instead of sleeping on the floor, the use of cots or bed nets will be implemented to reduce unwanted snake encounters during the night.

C) Farmers will be aware of the movement patterns of snakes. During the monsoon season, farmers will no longer walk into fields barefooted. Additionally, farmers will install underground "animal crossings" or tunnels for snakes to pass through, so that the run ins with farmers or vehicles become less hazardous for both parties.

III. The Irula will teach farmers how to take advantage of the predatory skills of snakes by properly administering them as natural pest control on their agricultural property.

IV. As the Irula see fit, they will pass their skill of handling snakes down to farmers. They will initially practice with non-venomous snakes, but will grow to be confident in handling any species of snake.

VI. The Irula will demonstrate proper procedures when dealing with snake bites and will advocate the importance of hospitals.

VII. The Irula will demonstrate how to extract venom from snakes, and how to manage the business of producing snake venom at a local scale.

Conclusion

The image of the snake in India, like most cultures, faces great adversity. While culture and religion depict snakes as powerful and godly beings, the subtext of these scriptures reveals a society rooted in both fascination and fear of the snake. As a result, this has distorted the snake's image so greatly that stigma of snakes has become reality for most of the inhabitants of India. This irrational fear and prejudice of snakes has altered not only man and snake's relationship to each other, but his relationship to his environment and personal health as well. In rural Maharashtra, conflicts between farmers and snakes have resulted in fatalities to both sides. Snakes are killed mercilessly out of fear and ignorance, and farmers become bitten by the snake they know nothing about. In an attempt to remedy the broken relationships of snakes and man, this paper proposed an integrative conservation method inspired by the tribal Irulas, or famous snake charmers of India. The Irulas themselves have fought against their own perceptions of snakes and have turned a new leaf that proved to be beneficial for both snakes and man. By attempting to follow the same path as the Irulas, many farmers can learn to see past their bias and welcome snakes as an asset to their farm rather than a nuisance. Execution of these cooperatives can signal the beginning of attitude changes with snakes and can establish a more fulfilling sustainable lifestyle for farmers.

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